IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| Applicant: | William C. Ulland | Examiner: | Stephen D. Rosasco |
| Serial No.: | 09/858,272 | Group Art Unit: | 1756 |
| Filed: | May 15, 2001 | Docket No.: | 2970.95US01 |
| Title: | DEVICES AND METHODS FOR EXPOSURE OF PHOTOREACTIVE COMPOSITIONS WITH LIGHT EMITTING DIODES | | |

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited in the United States Postal Service, as first class mail, with sufficient postage, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on August 12, 2003.

By: _____
Name: Cyndee Krenos



Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**DECLARATION OF DANIEL M. PAULY**

Dear Sir:

I, Daniel M. Pauly, declare and say as follows:

1. I am an attorney with the law firm of Merchant & Gould P.C., 3200 IDS Center, 80 South Eighth Street, Minneapolis, Minnesota 55402-2215, and I am a representative of the Applicants in the above-identified patent application.

2. I have read and am thoroughly familiar with the Office Action dated February 12, 2003 in the above-identified application and with the Piao Publication No. US 2002/0115021 A1 cited therein, and make this Declaration in support of the patentability of the claims of application Serial No. 09/858,272.

3. Attached as Exhibit 1 is an invention disclosure of the claimed subject matter from one of the named inventors (Alexander Gybin). On December 15, 2000 I received this document that shows invention of the claimed subject matter of the pending application is

before Piao was filed on February 1, 2001. Although the Piao publication claims a United States priority date before the filing date of the pending application, the date of invention of the subject matter of the pending application allows the inventors to swear behind the Piao publication (i.e., conception of the invention prior to the effective date of the reference).

4. I further declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon.

Date: August 12, 2003

Daniel M. Pauly
Reg. No. 40,123

DMP:ck

# FAX MESSAGE

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ISO 9001 Certified

DATE: 12/14/00

TO: Daniel Pauly

FROM: Alex Gybin

# OF PAGES: 3 (INCLUDING THIS ONE)



MESSAGE:

Dear Daniel,

Enclosed please find the invention disclosure for your review.

I will be calling you tomorrow to discuss it and will be happy to provide additional explanations.

Best regards,

Alex Gybin,
Senior Scientist, Ph.D.

The idea is to use LEDs (Light emitting diodes) as a light source in a 'printer' to expose light sensitive film for silk screen applications, or applications alike.

Screen printing films and emulsions are utilizing light energy in the near UV and in the blue region of visible light (up to ~420-30 nm).
Until recently, there were no LEDs that emit light in the range utilizable for exposure of such products. Just very recently some LEDs were found of being able to emit in 370-400nm range. Furthermore. it was found that very same LED could emit light in two distinctive ranges, for example peaking at 465 nm when regular voltage is applied to it, but change its emission to 380 nm when impulsion voltage is applied to it instead.
Few of these LEDs are available commercially, emitting (as an example) at 390&465nm and at 370&430nm.

Construction of the proposed printing devise to expose light sensitive stencil is described below.

A set of LEDs (for example 64, 8x8 square) is assembled into an "exposure head" and light sensitive material (film) is brought close to the head. After positioning complete, some LEDs in the head assembly are selectively switched 'on' to expose designated areas of the film. Then the head (or the film) is moved farther to expose other areas.
In this manner film is exposed by a 'contact exposure' method, similar to that of *contact printing* in photography. Imaged areas of the film in this case are created exactly of the same size as the contact negative, and in case of LEDs, to the size of the "exposure head" LEDs themselves.
With size of modern LEDs being rather large - 1-3 mm in diameter - it is impossible to create exposed dots of 25-50 microns in diameter. Therefore the light of LEDs has to be condensed somehow to this desired size of the exposed dots.

There are several ways to condense light from rather large LED into a very small projected dot.

One way is to project light of LED thorough reducing lenses (similar to that of MACRO mod of regular photo-camera's lenses). For this, the LEDs are assembled into flat or curved frame and emitting light is projecting image onto film therefore exposing it. Disadvantage of this method is that "exposure head" must be integral, combining both LEDs and focusing lenses, therefore making the head rather large.

Use of the focusing fiber optic could be another way to solve the problem of reducing LED's image-beam.

With this, one – large – end of the fiber could be attached directly to the LED, and another – reduced in diameter - end will provide condensed to the desired dot-size light output. Several fibers (by number of LEDs) will then be assembled into an "actual exposure head" of much smaller size than that that would be made of original size LEDs

With the miniaturized size of the 'exposure head' it would become possible to make precise imaging of the light sensitive film at high resolution. The dot size would be that of the smaller end of optic fiber.
This construction will also allow separating in space the LED-block (which is not have to be square but could be of any shape for ease of maintenance/assembly) and the actual exposure head (i.e. block of combined thin-ends of the fiber-optic).
Also, having flexible fiber optic connectors (from LEDs to the "head") would reduce dramatically the size of actual exposure head and therefore mechanism that would position it during exposure process will have less demanding requirements (weight, size, shape).

Additionally, the exposure head could integrate two sets of deferent type of LEDs that emit in two distinctive ranges, i.e. producing set of four exposure peaks: 370&430, and 390&465 nm, for example.
Importance of having two LEDs (with four band of exposure) comes from necessity of exposing various films or emulsions. As many of these products are made of several different types of light absorbing materials, it is important to expose them to a specific range of UV/Vis spectra for a specific time.
Having power of two different type of LEDs combined in one exposure hear provides an important tool for proper exposure of films of different photopolymer compositions.

In today state of the art exposure units light bulbs with specific light output in specific ranges are used. As long as power to them is on, they emit light energy disproportionally to a spectral range. For example, one bulb is emitting 5% of its energy at 320nm, 25% at 360nm, 10% at 390nm and the rest is above 450nm. If light sensitive film or emulsion formulated specifically to this particular light source would be used with another exposure unit (different bulb with different energy output ratio), results of the exposure would be dissatisfactory: some materials in the film would be overexposed with another remained non- or under-exposed. This is the case when two or more of different type and/or different photopolymerization mechanism materials are used in the same stencil product, for example what is called in the industry "dual-cure" or "triple cure".

With 4-band output LED exposure head it would be possible to use computerized exposure dosage for various light sensitive products.
For example, very same dot of the film would be consecutively exposed for, say, 1 sec with beam of 370nm, 4sec with beam at 390 and 2.5sec with 420nm. This exposure would be in exact proportion to the sensitivity of all light sensitive materials that are formulated into the film, resulting in perfectly exposed stencil.
Moreover, it is also opens an opportunity for formulators of light-sensitive products to do what was impossible before: to formulate stencil product based on interactive chemistry of its components rather than anticipating energy output of various light sources that are used in modern day industry.

It would also be possible to use this versatile LED light printer for proper exposure of any of stencil products that are currently exist on the market.